Rotating stratified turbulence as a model for the mesoscale energy cascade: insights and pitfalls

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The mesoscale kinetic energy spectrum has inspired research in geophysical turbulence since Gage and Nastrom first noted that it has a -5/3 slope. In the last few decades, atmospheric models have become increasingly good at reproducing the shape of the spectrum. Nevertheless, questions remain about the underlying energy cascade, including the role of gravity waves and stratified turbulence. Homogeneous rotating stratified turbulence (RST) - i.e. turbulence in a uniformly stratified f-plane, usually with periodic boundary conditions and idealized forcing - is a useful model for the mesoscale cascade. While it lacks several important features of atmospheric turbulence, such as convection and topography, RST captures at least some of the fundamental dynamics of the cascade. In this talk, I will present two investigations with RST: one that helps to understand results from more comprehensive models, and one that highlights a potential pitfall of RST experiments. In the first, I will show how vertical resolution and/or the choice of vertical mixing scheme can have a profound effect on the simulated cascade and energy spectrum. In the second, I will show that random forcing, which is commonly used to drive RST simulations, can artificially enhance the gravity wave spectrum, even when only slow geostrophic modes are forced. In both cases, results are explained in terms of the characteristic length and time scales of rotating stratified fluids, and implications for more realistic models are discussed.

Thursday, 7 February 2019, 3:30 p.m.

Refreshments 3:15 PM!

NCAR-Foothills Laboratory
3450 Mitchell Lane
FL2-1022, Large Auditorium

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